

## Chapter 19 Surge Protection

### 19-1. General

*a. Lightning-induced voltage surges.* Pumping stations are particularly vulnerable to lightning-induced voltage surges on incoming power lines, since it is characteristic of their operation to be in use during thunderstorms. Therefore, special care should be taken to reduce the magnitude of these voltage surges to avoid major damage to the electrical equipment contained within. A relatively small investment can greatly reduce the voltage stresses imposed on rotating machinery and switchgear by lightning-induced surges.

*b. Protective equipment.* There are two transient elements of a voltage surge that require different protective equipment. The protection of the major insulation to ground is accomplished by station surge arresters which limit the amplitude or reflections of the applied impulse waves within the motor windings. The protection of turn insulation by reducing the steepness of wave fronts applied to or reflected within the motor windings is accomplished by protective capacitors.

### 19-2. Medium-Voltage Motors

To obtain the most reliable protection of the motor's major and turn insulation systems, a set of arresters and capacitors should be installed as close as possible to the motor terminals. The arresters should be valve-type,

Station-Class designed for rotating machine protection. The capacitors should be of the non-PCB type. The leads from the phase conductor to the capacitor and from the capacitor to ground should be as short as possible. (If solid state motor controllers are used, the addition of capacitors at the motor terminals may not be recommended. Chopped-wave equipment such as SCR controlled motor starters can generate surges and harmonics. The capacitors can contribute to the problem by increasing resonance effects. The manufacturer should be consulted for the particular application.)

### 19-3. Low-Voltage Motors

Motors of 600 volts and below have relatively higher dielectric strength than medium-voltage machines. Normally, when higher speed motors of this voltage class are connected through a transformer protected by Station-Class arresters on the primary side, no additional protection is warranted. However, due to the more expensive slower speed motors employed in pump stations, plus the critical nature of these motors, the minimal additional cost of lightning protection is justified. A three-phase valve-type low voltage arrester should be provided at the service entrance to the station and a three-phase capacitor should be provided at each motor terminal.

### 19-4. Substation

The utility should be requested to supply valve-type Station-Class surge arresters on the primary side of the substation transformer.